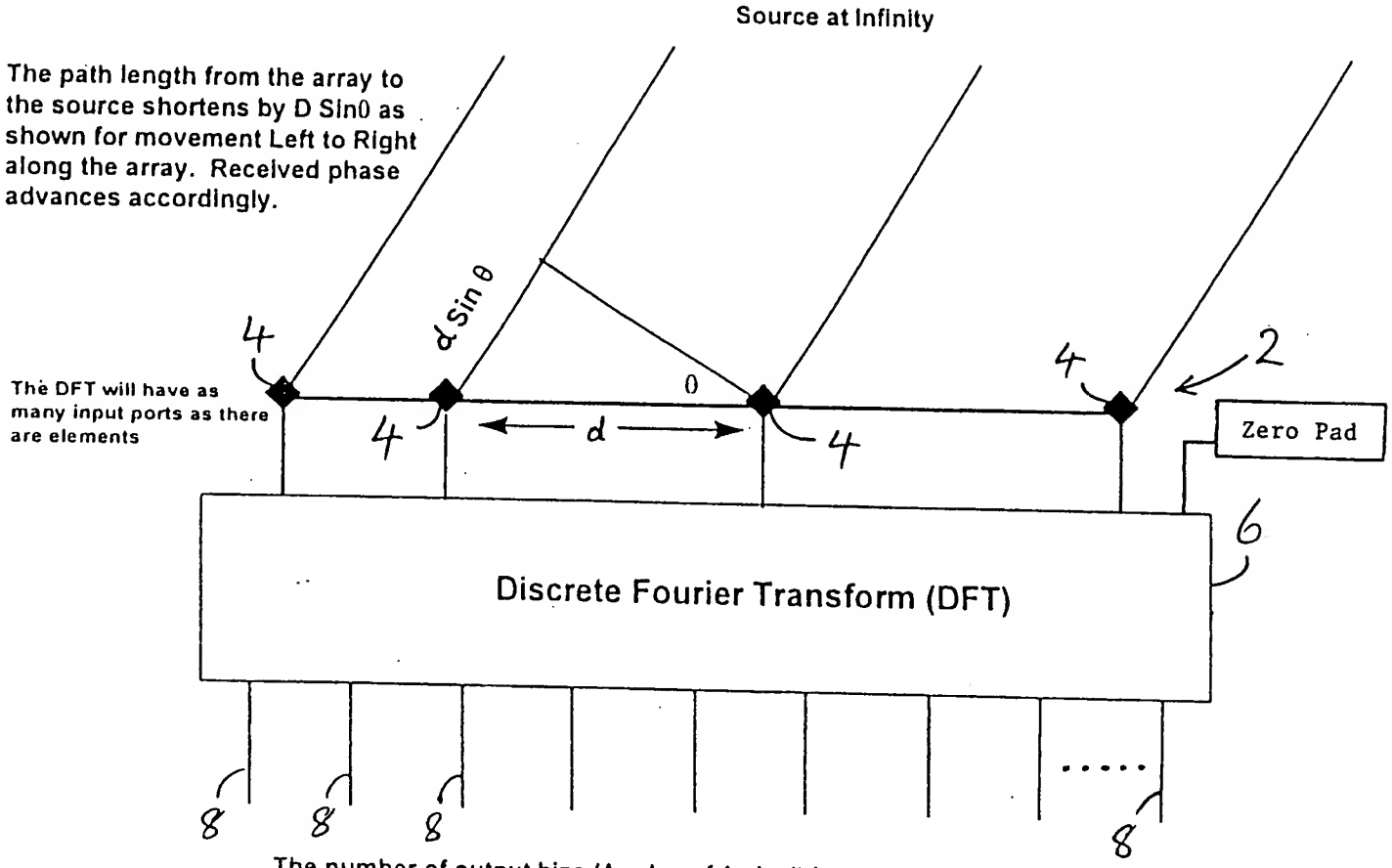


The number of output bins (Angles of Arrival) is selected on the basis of the required angle discrimination. Such discrimination and the sidelobe structure will be determined solely by the number and distribution of the input ports.

FIGURE 1

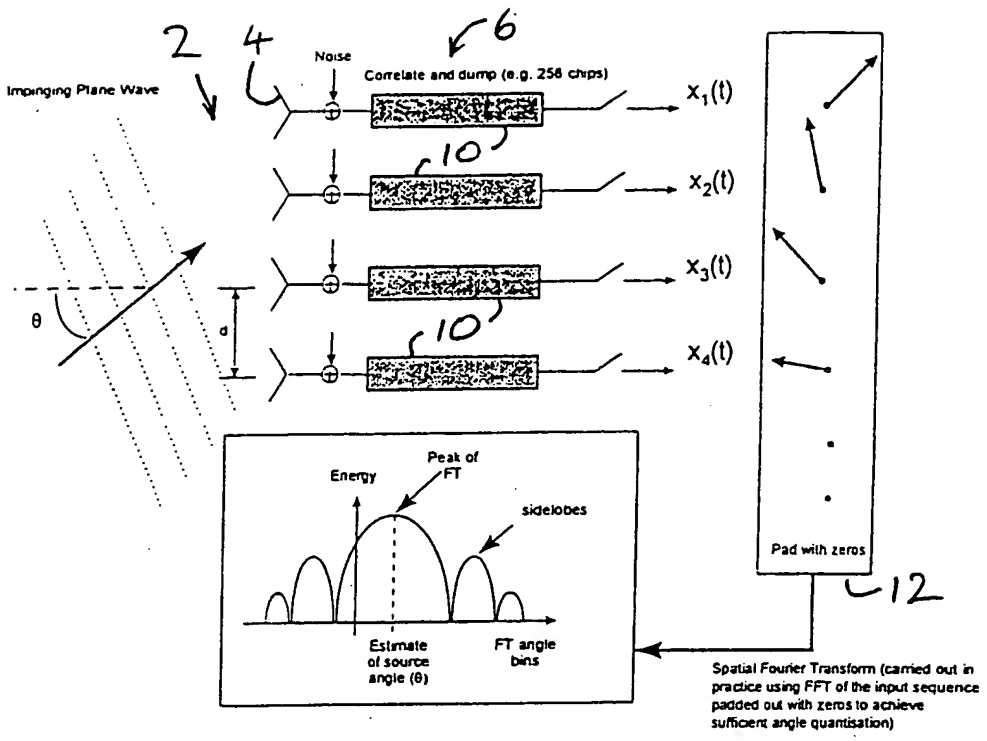


FIGURE 2

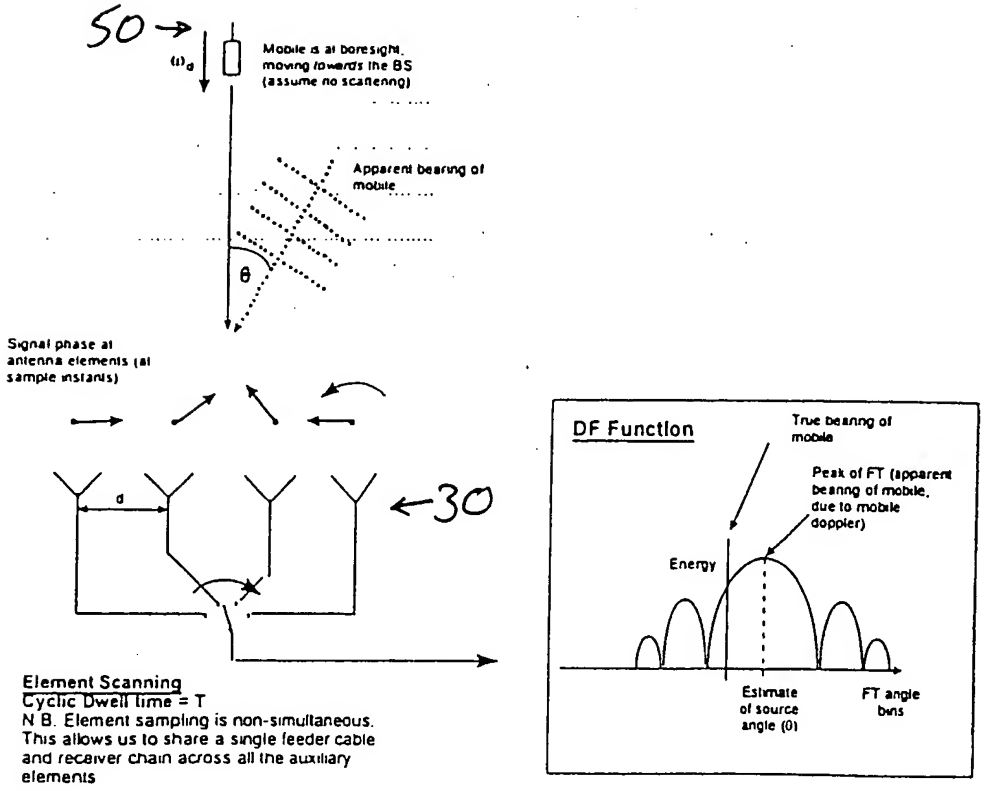


FIGURE 4

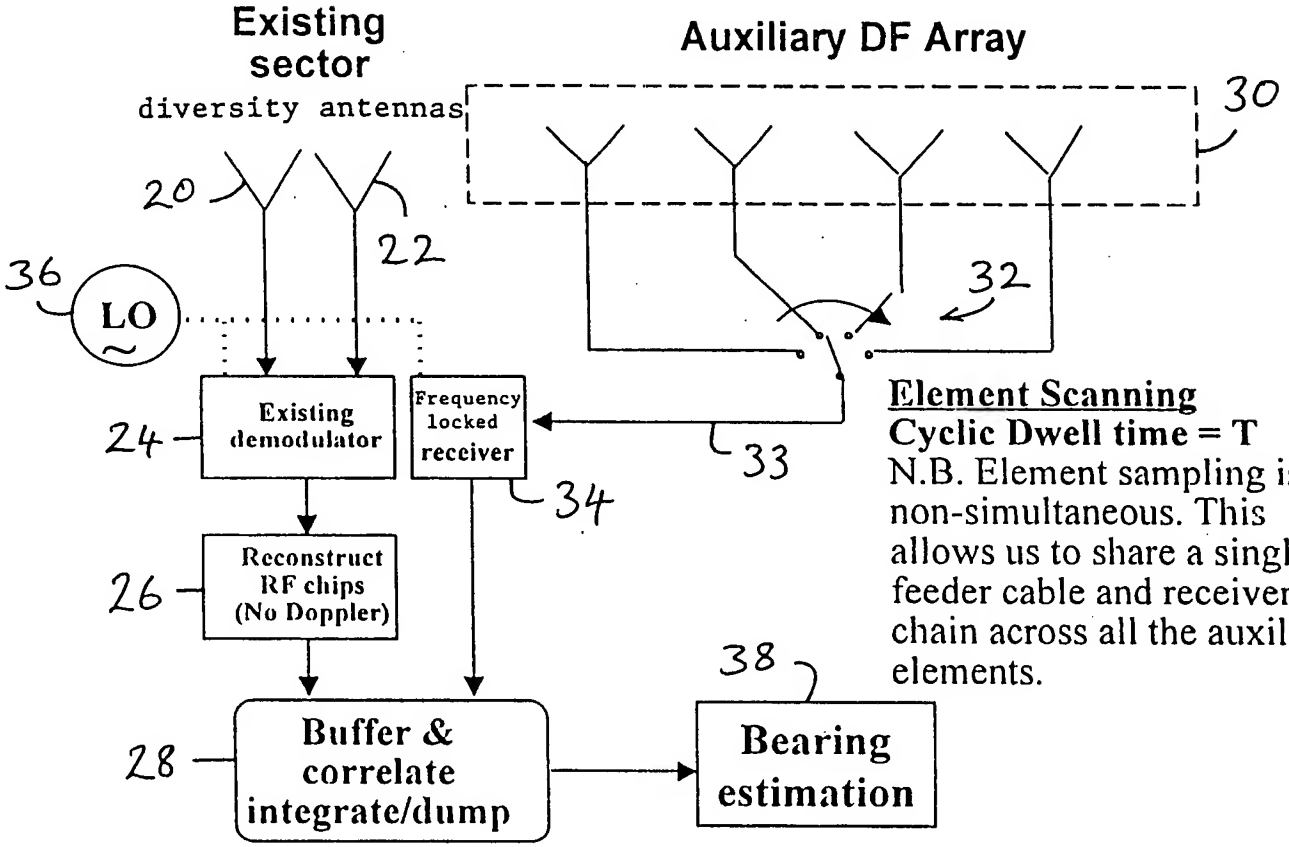

Existing sector
diversity antennas
Auxiliary DF Array
30
20
22
36
LO
32
24
Existing demodulator
Frequency locked receiver
33
34
26
Reconstruct RF chips (No Doppler)
38
28
Buffer & correlate integrate/dump
Bearing estimation
Element Scanning
Cyclic Dwell time = T
N.B. Element sampling is non-simultaneous. This allows us to share a single feeder cable and receiver chain across all the auxiliary elements.

FIGURE 3

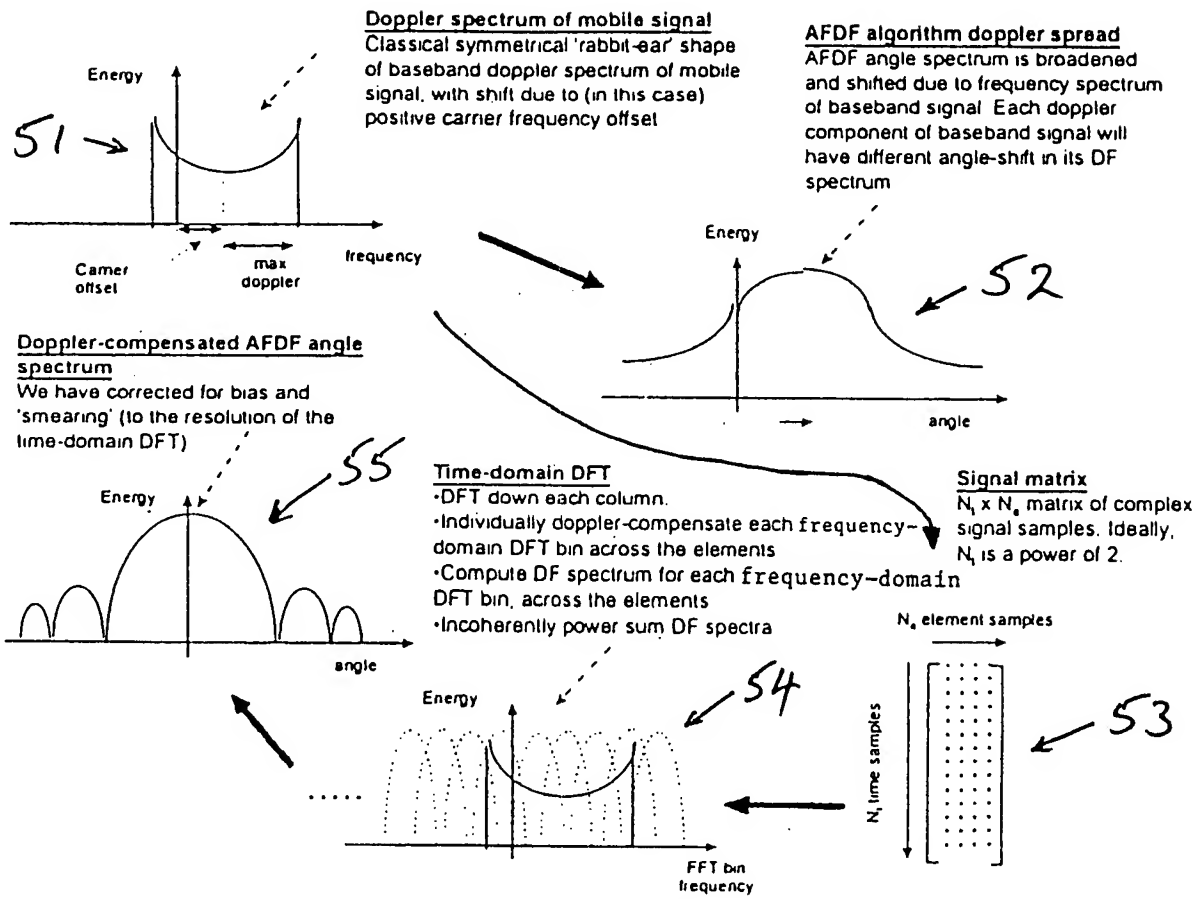

Doppler spectrum of mobile signal
Classical symmetrical 'rabbit-ear' shape of baseband doppler spectrum of mobile signal, with shift due to (in this case) positive carrier frequency offset
Energy
51
Carrier offset
max doppler
frequency
AFDF algorithm doppler spread
AFDF angle spectrum is broadened and shifted due to frequency spectrum of baseband signal. Each doppler component of baseband signal will have different angle-shift in its DF spectrum
Energy
52
angle
Doppler-compensated AFDF angle spectrum
We have corrected for bias and 'smearing' (to the resolution of the time-domain DFT)
Energy
55
angle
Time-domain DFT
•DFT down each column.
•Individually doppler-compensate each frequency-domain DFT bin across the elements
•Compute DF spectrum for each frequency-domain DFT bin, across the elements
•Incoherently power sum DF spectra
Signal matrix
N_t x N_e matrix of complex signal samples. Ideally, N_t is a power of 2.
N_e element samples
N_t time samples
53
Energy
54
FFT bin frequency

FIGURE 5

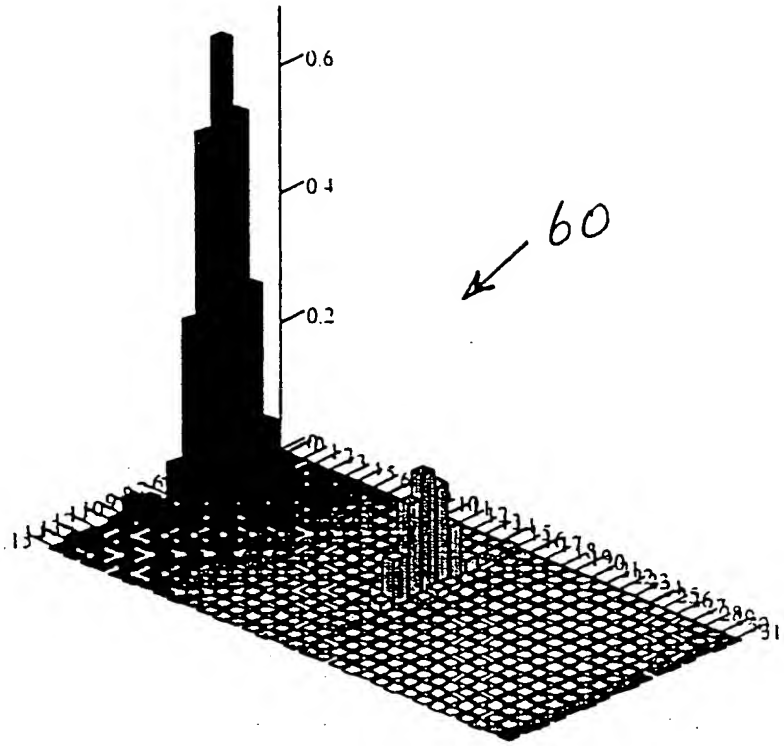
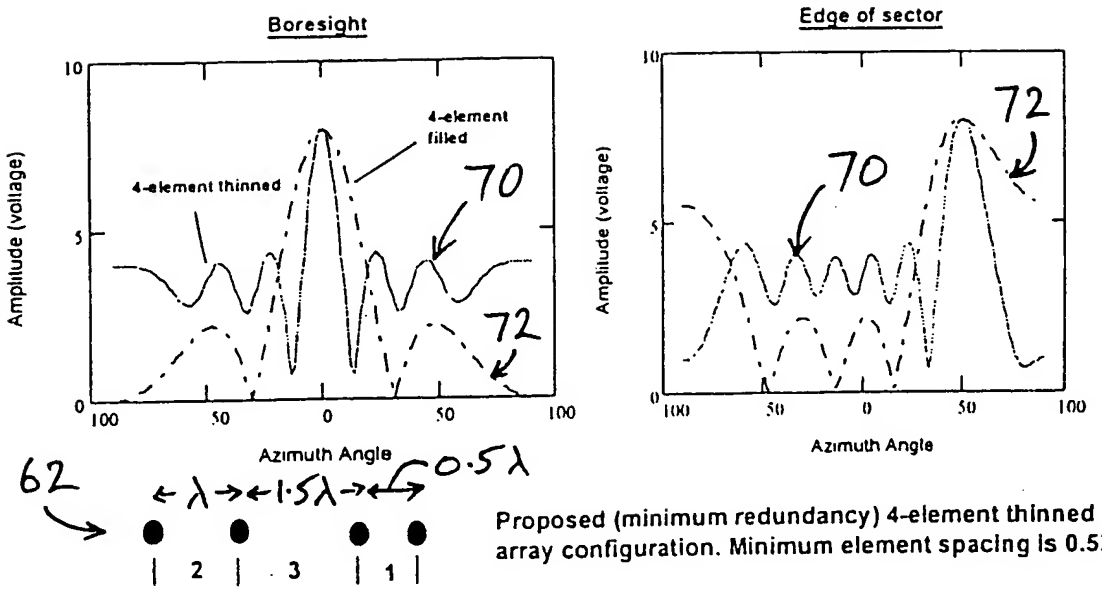


FIGURE 6



Proposed (minimum redundancy) 4-element thinned array configuration. Minimum element spacing is 0.5λ

- The selected thinned array configuration biases elements towards the edge of the available aperture and achieves a -3dB beam width of 11° (N.B. Narrower beamwidth than a 7-element filled array due to the 'end-weighting').

- Peak sidelobes close to the -6dB target level are achieved even when the main beam is scanned towards the edge of the sector.

FIGURE 7

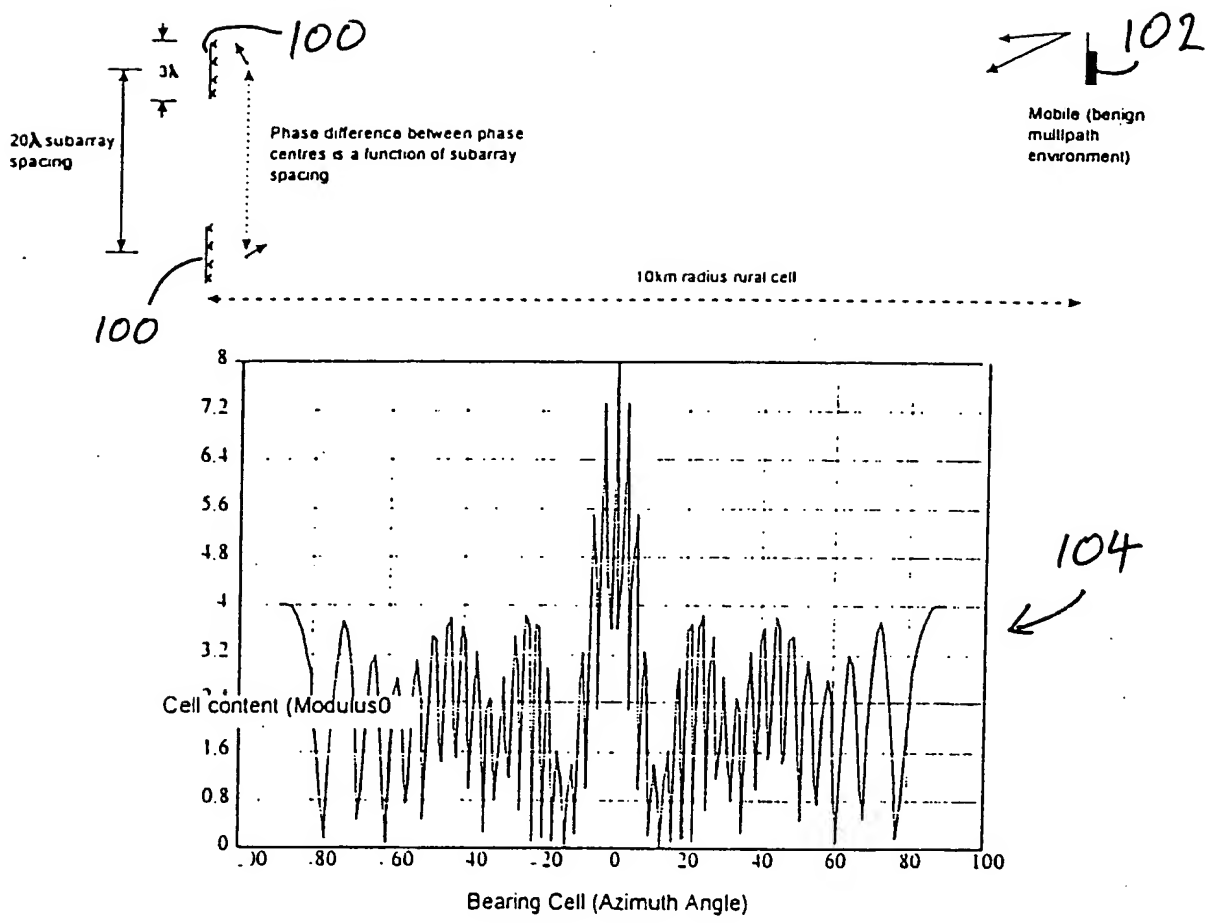

100
3λ
20λ subarray spacing
Phase difference between phase centres is a function of subarray spacing
100
102
Mobile (benign multipath environment)
10km radius rural cell
104
Cell content (Modulus0
8
7.2
6.4
5.6
4.8
4
3.2
1.6
0.8
0
-80
-60
-40
-20
0
20
40
60
80
100
Bearing Cell (Azimuth Angle)

FIGURE 8

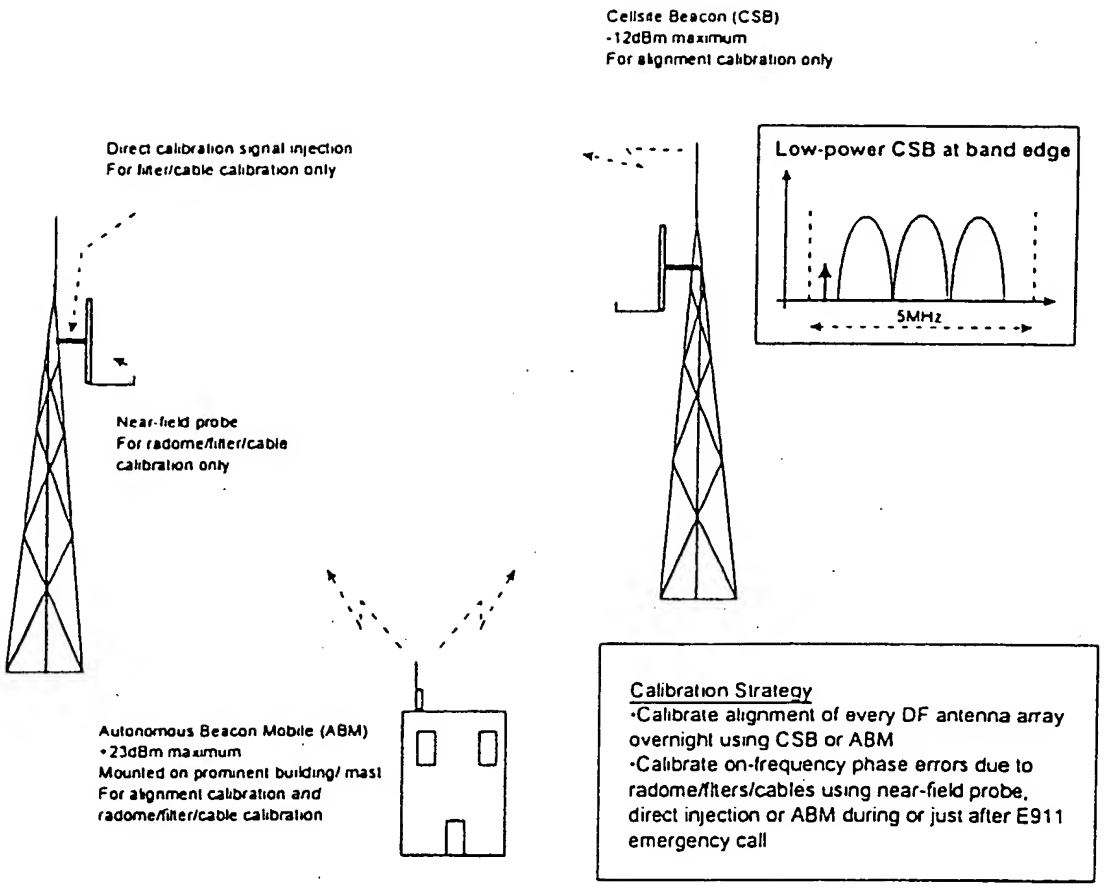

Cellsite Beacon (CSB)
-12dBm maximum
For alignment calibration only
Direct calibration signal injection
For antenna/cable calibration only
Low-power CSB at band edge
5MHz
Near-field probe
For radome/filter/cable
calibration only
Autonomous Beacon Mobile (ABM)
+23dBm maximum
Mounted on prominent building/ mast
For alignment calibration and
radome/filter/cable calibration
Calibration Strategy
•Calibrate alignment of every DF antenna array overnight using CSB or ABM
•Calibrate on-frequency phase errors due to radome/filters/cables using near-field probe, direct injection or ABM during or just after E911 emergency call

FIGURE 9

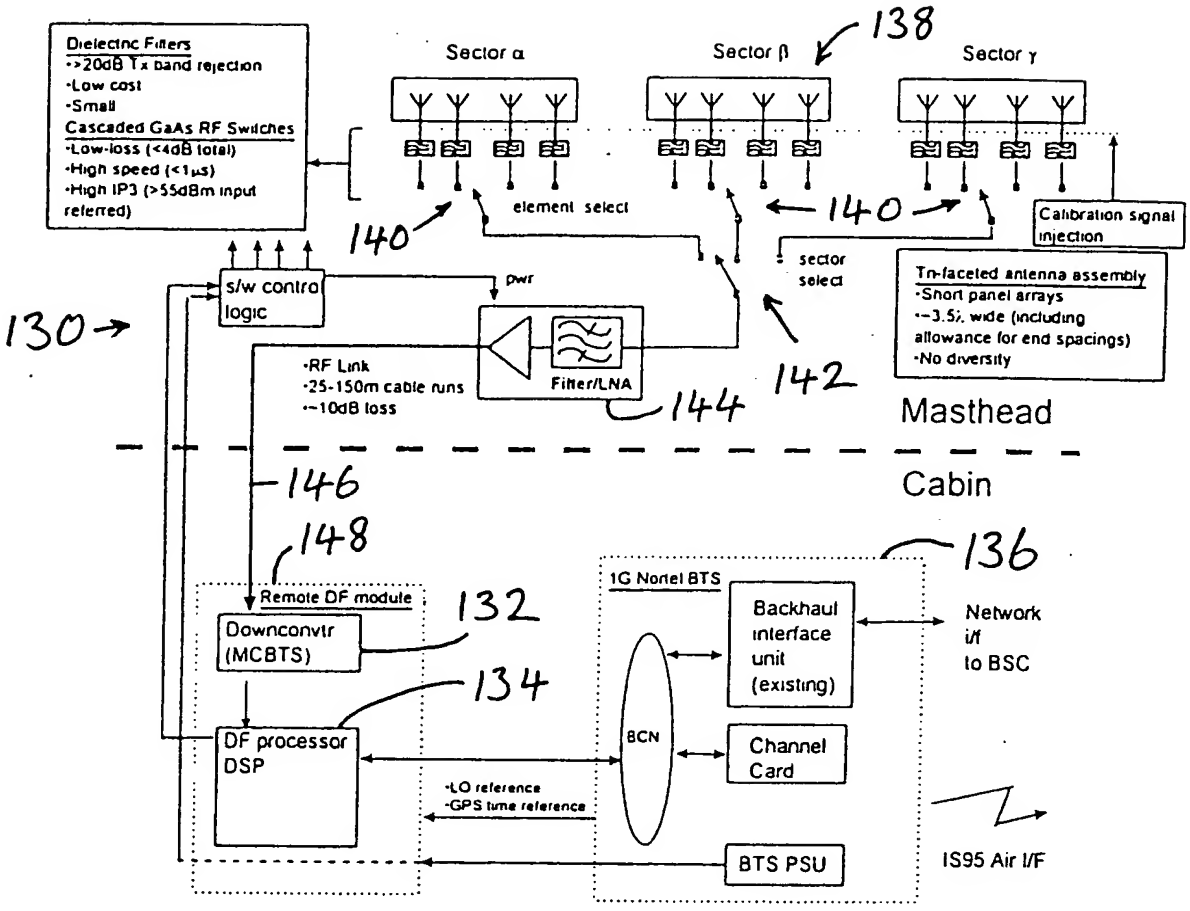

Dielectric Filters
•>20dB Tx band rejection
•Low cost
•Small
Cascaded GaAs RF Switches
•Low-loss (<4dB total)
•High speed (<1μs)
•High IP3 (>55dBm input referred)
Sector α
Sector β
Sector γ
138
element select
140
140
sector select
Calibration signal injection
Tri-faceted antenna assembly
•Short panel arrays
•~3.5λ wide (including allowance for end spacings)
•No diversity
s/w control logic
pwr
130
•RF Link
•25-150m cable runs
•~10dB loss
Filter/LNA
144
142
Masthead
Cabin
146
148
136
1G Nortel BTS
Remote DF module
132
Downconvtr (MCBTS)
134
DF processor DSP
•LO reference
•GPS time reference
BCN
Backhaul interface unit (existing)
Channel Card
BTS PSU
Network i/f to BSC
IS95 Air I/F

FIGURE 10

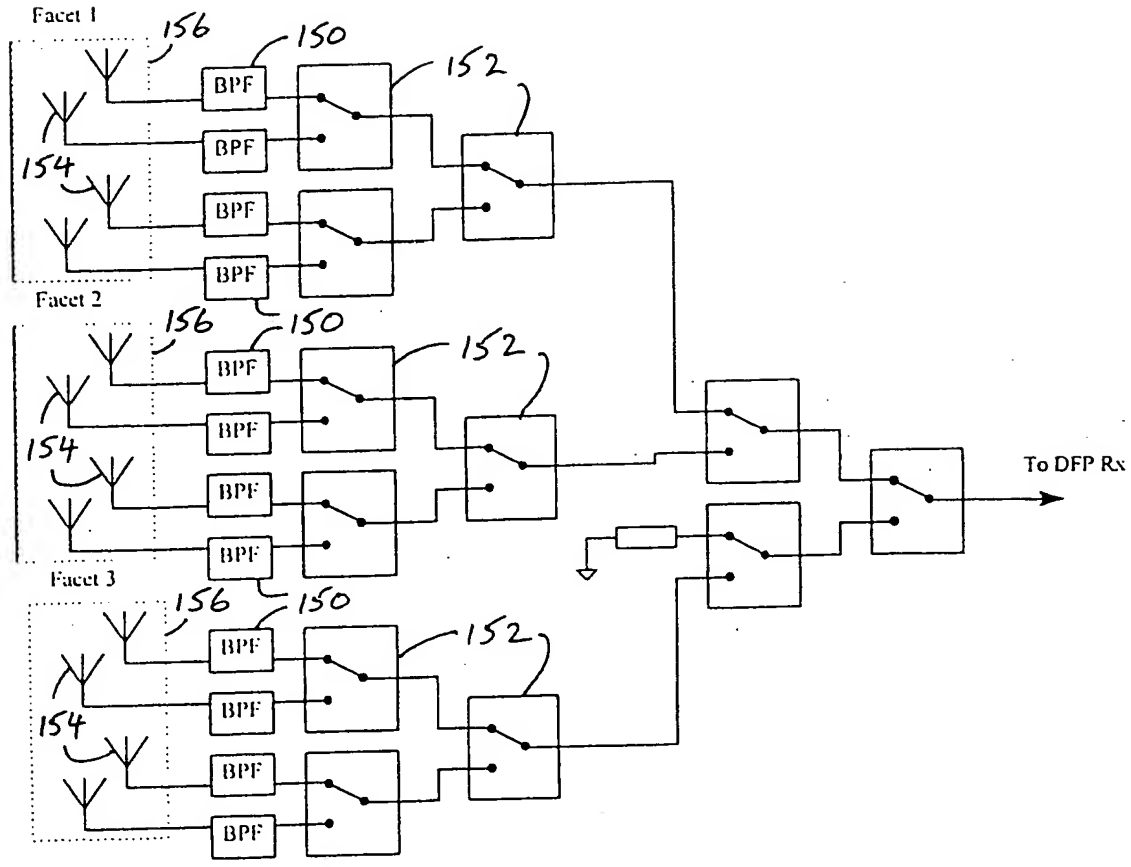

Facet 1
156
150
152
BPF
BPF
154
BPF
BPF
Facet 2
156
150
152
BPF
BPF
154
BPF
BPF
Facet 3
156
150
152
BPF
BPF
154
BPF
BPF
To DFP Rx

FIGURE 11